injections of a highly purified FSH preparation has been investigated. At a total dose level of 12.5 mg no microscopic changes in the testes of male mice were observed, although some weight increment was evident. In female mice the uterus showed greater sensitivity to hormone injections than did the ovaries.

1. Li, C. H., Simpson, M. E., and Evans, H. M., *Science,* 1949, v109, 445.

2. Li, C. H., *Vitamins and Hormones,* 1949, v7, 223.

3. Simpson, M. E., Li, C. H., and Evans, H. M., *Endocrinology,* 1951, v48, 370.

Received February 26, 1952. P.S.E.B.M., 1952, v79.

Encephalitis in Midwest IX. Neutralizing Antibodies in Wild Birds of Midwestern States. (19427)

CLARENCE A. SOOTER, BEATRICE F. HOWITT, AND RACHAEL GORRIE.

From the Communicable Disease Center, Public Health Service, Atlanta, Ga.

In the virus diseases termed the arthropod-borne encephalitides, considerable work points definitely toward birds as biological reservoirs of these viruses, including St. Louis encephalitis, Japanese B encephalitis, and Eastern and Western equine encephalomyelitis. The literature describes the possible part birds may play as reservoirs and their possible role in the infection of man with one of these viruses(1-7). The present paper deals with wild birds and results of blood serum surveys in Colorado, Kansas, and Missouri in 1949, in which several species of birds have been sampled and tested for past infections of the St. Louis (St. L.) and Western equine encephalomyelitis (WEE) viruses. These collections were a part of an extensive search for natural reservoirs of these organisms.

Methods. Surveys were made in Kansas and Missouri in 1949 from late spring through the fall. Samples were collected in Colorado during the third week of November 1949. Species sampled and results of tests are given in Table I and Table II. The majority of the waterfowl blood samples was obtained through cooperation of the U. S. Fish and Wildlife Service personnel during banding operations at Swan Lake and Squaw Creek National Wildlife Refuges in Missouri. These blood samples were taken from the wing veins. Other bloods were taken from birds collected during special surveys in southeastern and western Kansas and in Weld County, Colorado. During the Colorado survey, turkey and chicken sera were also collected for testing. The turkeys sampled were mature-sized birds reared from poults that year and were bled at a Greeley, Colo., processing plant just prior to slaughter. The chickens were full grown and of various ages. Blood was sampled just prior to slaughter at a Greeley processing plant. Both the chickens and turkeys were from flocks in Weld County and surrounding counties. The sera were tested for neutralizing antibodies against St. L. and WEE viruses according to a modification of the methods given in the U. S. Army Laboratory Manual(8). All sera were inactivated at 56°C for 30 minutes. The serum virus mixtures were prepared in the late afternoon and held overnight in the refrigerator before they were used to inoculate mice intracerebrally. Neutralization indices of 50 or more were regarded as positive and those between 32 and 50 as equivocal.

Results. It will be noted in Table I that incidence of past infections was relatively low in the specimens collected in Kansas and Missouri, with 13 of 112 or 11.6 per cent showing evidence of having had Western equine encephalomyelitis, and no incidence of St. Louis virus in 68 specimens. It was interesting and deemed noteworthy that all of the positives in Table I were in migratory birds. Also few human or equine encephalomyelitis cases were reported during 1946 through 1949 in these states or in other localities where these birds might have been

TABLE I. Results of Neutralization Tests on Bird Sera Collected in Kansas and Missouri, 1949.

		Tested WEE	Pos. WEE	Tested St.L.	Pos. St.L.
Pied-billed grebe	*Podilymbus p. podiceps*	1	1	—	—
Canada goose	*Branta canadensis*	27	0*	25	0
Mallard duck	*Anas p. platyrhynchos*	22	3†	14	0
Swainson's hawk	*Buteo swainsoni*	4	2	1	0
Sparrow hawk	*Falco sparverius*	1	0	—	—
Eastern bob-white	*Colinus v. virginianus*	3	0	—	—
American coot	*Fulica a. americana*	5	2	—	—
Golden plover	*Pluvialis d. dominica*	2	0	2	0
Mourning dove	*Zenaidura macroura*	10	0	4	0
Red-headed woodpecker	*Melanerpes erythrocephalus*	1	0	—	—
Eastern kingbird	*Tyrannus tyrannus*	2	2	—	—
Cliff swallow	*Petrochelidon a. albifrons*	1	0	—	—
Eastern crow	*Corvus brachyrhynchos*	13	0	11	0
Eastern robin	*Turdus m. migratorius*	1	0	1	0
Meadowlark	*Sturnella neglecta*	3	0	1	0
Red-winged blackbird	*Agelaius phoeniceus*	3	0	3	0
Rusty blackbird	*Euphagus carolinus*	2	1	2	0
Brewer's blackbird	*Euphagus cyanocephalus*	3	2	1	0
Bronzed grackle	*Quiscalus versicolor quiscula*	1	0	1	0
Eastern cowbird	*Molothrus a. ater*	2	0	—	—
English sparrow	*Passer d. domesticus*	5	0	2	0
	Total	112	13 (11.6%)	68	0

* 1 was equivocal. † 2 others equivocal.

TABLE II.

A. Results of neutralization tests on bird sera collected in Colorado, 1949

		Tested WEE	Pos. WEE	Tested St.L.	Pos. St.L.
Green-winged teal	*Anas carolinense*	1	0	—	—
Pheasant	*Phasianus colchicus torquatus*	1	1	—	—
Pigeon	*Columba l. livia*	3	2	2	0
Desert horned lark	*Otocoris alpestris leucolaema*	1	0	—	—
Magpie	*Pica p. hudsonia*	11	4*	1	0
Meadowlark	*Sturnella neglecta*	3	0	2	0
Red-winged blackbird	*Agelaius phoeniceus*	3	0	1	0
English sparrow	*Passer d. domesticus*	4	0†	—	—
House finch	*Carpodacus mexicanus frontalis*	1	0	—	—
	Total	28	7(25%)	6	0

B. Results of neutralization tests on domestic fowl sera collected in Colorado, 1949

	Tested WEE	Pos. WEE	% positive	Tested St.L.	Pos. St.L.	% positive
Turkey	38	11	29	41	0	0
Chicken	23	7	30.4	21	0	0

* 2 others equivocal. † 1 was equivocal.

at some time during their migrations, wintering, or nesting activities. In contrast, all of the positive serum samples collected in Colorado (Table II) were from resident species of the area being investigated. This was significant in that a small epidemic of WEE had occurred just previously in people and horses in this part of Colorado. This pointed toward local sources of virus infection in nature and was supported by field work in this investigational area the following summer (1950). During that season, nestling bird bloods containing WEE virus were collected on 3 different occasions(12).

The presence of WEE neutralizing antibodies in 29% of the turkeys and 30.4% of the chickens (Table II B) also indicated local sources of virus.

Discussion. The above results support past references that birds are involved in WEE outbreaks. The exact role they play is not as yet known. The host range of these encephalitis viruses among bird species in nature is known only partially and future surveys and investigations will undoubtedly continue to add to present lists. In the Missouri-Kansas investigational area we know that 7 species (Table I) may be involved. These represent only a small percentage of the several hundred species of birds that frequent this region at some time during the year. In Colorado four of the approximately 365 species and subspecies frequenting this area have been found with positive neutralizing antibodies for WEE or with a viremia for WEE (Table II)(12, 16).

Surveys of this type are deemed important in that they reveal evidences of past inapparent infections and presence of virus in nature when few or no human or horse cases occur. Often bird infections go undetected because evidence of St. L. and WEE infection in domestic and wild birds is usually characterized by a lack of any apparent clinical evidence of infection(13). Conversely, Eastern equine encephalomyelitis is known at times to be fatal to a high percentage of some of our common birds(7-11). Results from these serum surveys are also of value for correlation with findings of blood sucking parasites of birds being infected with WEE and St. L. viremia(7,14,15).

Comment. This information is given to emphasize the possible importance of birds in outbreaks of the above-mentioned arthropod-borne encephalitides, as well as to help prevent possible misinterpretation of findings relative to various bird species.

Summary. Serum surveys for St. Louis and WEE neutralizing antibodies in migratory and resident wild birds in midwestern states during 1949 showed 11.6% of birds with positive WEE neutralizing antibodies in Kansas and Missouri area where little or no encaphalitis occurred. This is compared with a survey in Colorado during 1949 following a small WEE epidemic when the sera of 25% of resident wild birds showed positive WEE neutralizing antibodies.

1. Howitt, B. F., and Van Herick, W., *J. Inf. Dis.*, 1942, v71, 179.

2. Reeves, W. C., Proc. 49th Ann. Meet. U. S. Livestock Assn., Dec. 1945, p150.

3. Cox, W. R., Jellison, W. L., and Hughes, L. E., *Pub. Health Rep.*, 1941, v56, 1905.

4. Hammon, W. McD., Reeves, W. C., and Sather, Gladys E., *Am. J. Hyg.*, 1951, v53, 249.

5. Hammon, W. McD., *Am. J. Trop. Med.*, 1947, v28, 515.

6. ———, Proc. and Papers 16th Ann. Conf. Calif. Mosquito Abatement Assn., Feb. 1948, 4.

7. Davis, W. A., *Am. J. Hyg.*, 1940, v32, 45.

8. Simmons, J. S.. and Gentzkow, C. J., *Laboratory Methods of the U. S. Army*, Lea and Febiger, Phila., 1944.

9. Van Rockel, H., and Clarke Miram K., *J. Am. Vet. Med. Assn.*, 1939, v94, 466.

10. Beaudette, F. R., and Hudson, C. B., *J. Am. Vet. Med. Assn.*, 1945, v107, 384.

11. Beaudette, F. R., and Black, J. J., *J. Am. Vet. Med. Assn.*, 1948, v112, 140.

12. Sooter, Clarence A., Howitt, B. F., Gorrie, Rachael, and Cockburn, T. Aidan, PROC. SOC. EXP. BIOL. AND MED., 1951, v77, 393.

13. Reeves, William C., *Am. J. Pub. Health*, 1951, v41, 678.

14. Hammon, W. McD., Reeves, W. C., Cunha, R., Espana, C., and Sather, G., *Science*, 1948, v107, 92.

15. Miles, Virgil I., Howitt, Beatrice F., Gorrie, Rachael, and Cockburn, T. Aidan, PROC. SOC. EXP. BIOL. AND MED., 1951, v77, 395.

16. Niedrach, Robert J., and Rockwell, Robert B., *The Birds of Denver and Mountain Parks.* The Colo. Museum of Nat. Hist. Popular Series No. 5. Denver, 1939.

Received February 25, 1952. P.S.E.B.M., 1952, v79.